(12) UK Patent Application (19) GB (11) 2 197 276 (13) A

(43) Application published 18 May 1988

(21) Application No 8623255

(22) Date of filing 26 Sep 1986

(71) Applicant
Airship Industries (U.K.) Limited

(Incorporated in United Kingdom)

Bond House, 347–353 Chiswick High Road, London W4 4HS

(72) Inventor
Reginald Harold Hillsdon

(74) Agent and/or Address for Service
Boult, Wade & Tennant,
27 Furnival Street, London EC4A 1PQ

(51) INT CL[4]
B64B 1/30

(52) Domestic classification (Edition J):
B7W 11A7
F1V 100 210 B
U1S 1841 B7W F1V

(56) Documents cited
GB 1130531 GB 1118117

(58) Field of search
B7W
F1V
Selected US specifications from IPC sub-classes B64B B64C

(54) Improvements in airships

(57) Control apparatus 13 for an airship 10 comprising a rotor assembly 14 having a plurality of propellor blades 17 of variable pitch mounted on a rotatable hub 16 at an acute angle relative to the axis of rotation of the rotor assembly, a power source 15 for driving the rotor assembly and a mechanism for controlling the pitch of the blades, enabling the control apparatus to provide compensation for pitching and yawing motions of the airship as well as to propel the airship. Pitch control includes cyclic and collective elements.

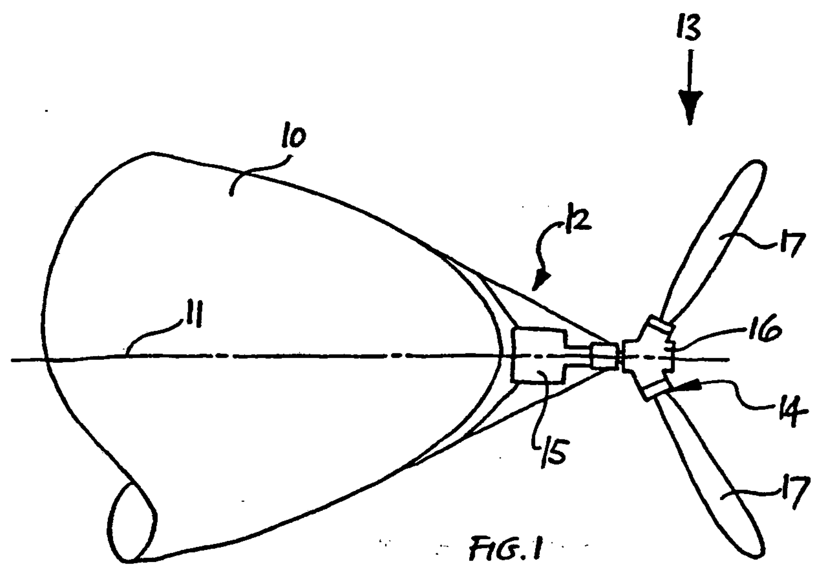

FIG.1

GB 2 197 276 A

26 SEP. 86- 23255
DFA

2197276

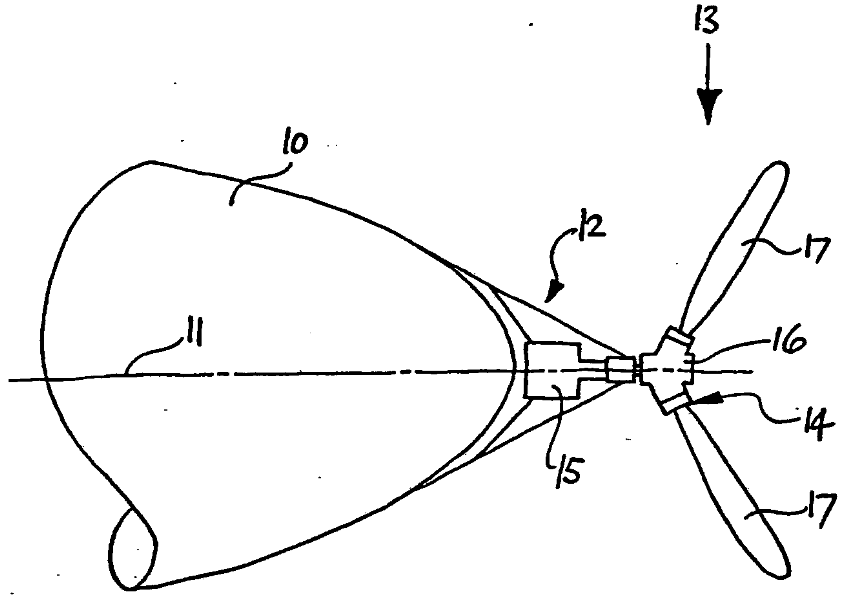

FIG. 1

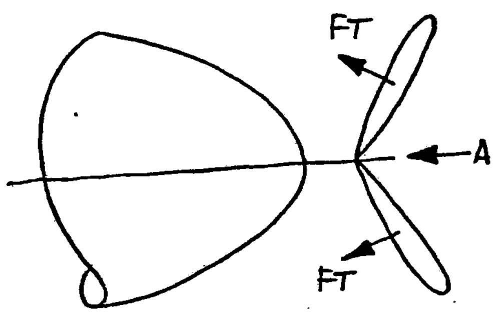

FIG. 2A

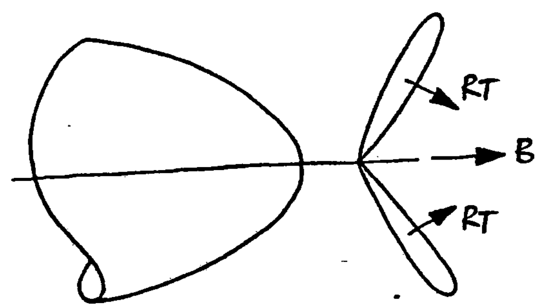

FIG. 2B

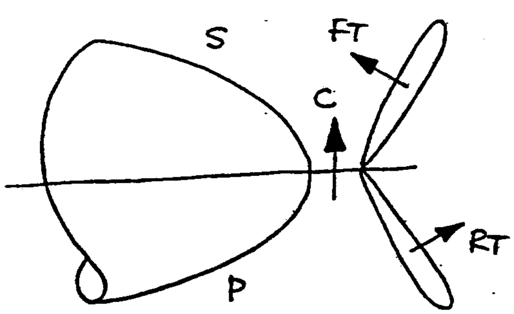

FIG. 2C

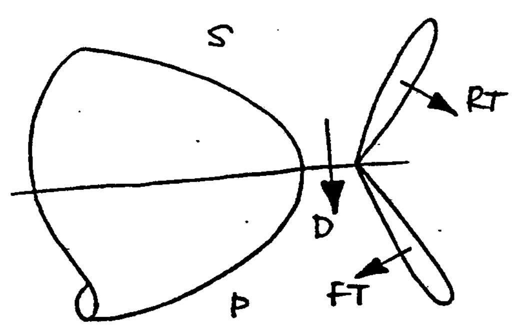

FIG. 2D

SPECIFICATION

Improvements in airships

This invention relates to airships and in particular to airship control apparatus.

The invention provides airship control apparatus comprising rotor means rotatably mounted on the airship, which rotor means includes one or more blade means of variable pitch fixedly mounted at an acute angle relative to the axis of rotation of the rotor means, and means for driving the rotor means.

The rotor means preferably further includes control means to adjust the pitch of the blade means while the rotor means is rotating. The rotor means preferably comprises a plurality of propellor blades and the pitch control means is able to vary the pitch of the propellor blades collectively and each equally.

The pitch control means is preferably able to vary the pitch of the propellor blades cyclically whereby the pitch of the blades varies over the course of each revolution.

In the case where the airship is elongate, the rotor means is preferably mounted at at least an end of the airship, and the axis of rotation of the rotor means is preferably coincident with the longitudinal axis of the airship.

The control apparatus may further include means to operate the rotor means and pitch control means to compensate automatically for pitching and yawing motions of the airship.

By way of example, an embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a plan view showing airship control apparatus according to the invention, and

Fig. 2A, 2B, 2C and 2D are plan views showing diagrammatically various modes of control.

In Figure 1 there is seen the end section of an elongate airship 10 having a longitudinal axis 11. The end section may be the nose or stern of the airship 10. Attached to the hull of the airship 10 at this end is a suitable structure 12 which carries the control apparatus 13. The airship 10 may be provided with more than one control apparatus. The control apparatus 13 comprises a rotor assembly 14 which is driven by a power source 15. The axis of rotation of the rotor assembly 14 is arranged coincidently with the longitudinal axis 11 of the airship 10. The rotor assembly 14 comprises a rotatably mounted hub 16 to which are fixedly attached a plurality of propellor blades 17. As can be seen in Figure 1, the blades 17 are fixed at an acute angle relative to the axis of rotation of the rotor assembly 14. The rotor assembly 14 includes a mechanism capable of adjusting the pitch of the blades 17 while the rotor assembly is rotating. The pitch of the blade is varied by rotating the blade about its central axis. Such pitch control mechanisms are known from helicopter rotor technology and may take the form, for example, of an external swash plate control or an internal actuator rod control. The pitch of each blade is adjustable at will to vary the thrust from the blade between a maximum value in one direction and a maximum value in the opposite direction. The pitch control mechanism here is able not only to adjust the pitch of the blades equally and collectively, i.e. all by the same amount, but also to vary the individual blade pitch cyclically. This is explained in more detail with reference to Figures 2A to 2D.

The fact that the blades 17 are fixed at an acute angle on the hub 16 means that, on rotation, they sweep in a conical fashion, as opposed to the planar sweep of more conventional propellor blades. The advantage of this will be understood from a consideration of various modes of airship control, explained in simplified terms with reference to Figures 2A to 2D.

In Figure 2A, the pitch control mechanism has been used to adjust all the blades equally to what can be termed a forward collective pitch. The thrust from each rotating blade is indicated in Figure 2A by arrow FT. It will be seen that this produces a combined component of forward thrust in the direction of arrow A, urging the airship forwardly. It will be noted that there is no net lateral thrust produced in this control mode. The airship is thus propelled forwardly along the line of its longitudinal axis.

In Figure 2B, the situation is reversed. The pitch control mechanism has been used to adjust all the blades equally to what can be termed a rearward collective pitch. The rearward thrust from each rotating blade is indicated in Figure 2B by arrow RT. The net result is a combined component of rearward thrust, arrow B, propelling the airship rearwardly along the line of its longitudinal axis.

In Figure 2C, the pitch control mechanism has been used to make a cylic pitch adjustment of the blades. This means that the pitch of each blade varies over the course of each revolution, with each blade varying in the same manner. Here, the blades are adjusted to have a forward pitch when on the starboard side S of the airship and a rearward pitch when on the port side P. The effect of this is that the rotor assembly produces a forward thrust, arrow FT, on the starboard side and a rearward thrust, arrow RT, on the port side. It will be seen that the net result is a lateral thrust in the direction of arrow C, urging the end of the airship to starboard. By the symmetry of the blades and the thrust thereby, there is no net thrust on the airship in Figure 2C along the line of its longitudinal axis.

In Figure 2D, the situation is the reverse of that depicted in Figure 2C. The pitch control mechanism has been used to adjust the

blades to have forward pitch when on the port side P and rearward pitch when on the starboard side S. The blades therefore produce forward thrust, arrow FT, on the port side P and rearward thrust on the starboard side S with a net result of a lateral thrust in the direction of arrow D, urging the end of the airship to port. Again, from the blade symmetry, there is no net force urging the airship along the line of its longitudinal axis.

The above examples of airship control modes can of course be combined, for example, to provide a component of lateral thrust together with a component of longitudinal thrust. Furthermore, it will be appreciated that the lateral thrust described above may be in the horizontal plane, as in relation to the Figures 2C and 2D modes, and equally also in the vertical plane, or a combination of both. In this Way, the pitching and yawing motions of the airship may be controlled together with its airspeed.

The airship carries the usual gondola underneath its midsection, and the gondola can conveniently house the pitch adjustment controls for the rotor assembly. An automatic control system, e.g. by computer, can advantageously be provided for operating the pitch adjustment control, with detecting devices for monitoring such parameters as airship speed relative to windspeed, as well as bearing, attitude, angle of inclination etc. of the airship.

One of the advantages of such airship control apparatus is that it enables the possibility to hold the airship still in a fixed position in the air by positive control.

CLAIMS

1. Airship control apparatus comprising rotor means rotatably mounted on the airship, which rotor means includes one or more blade means of variable pitch fixedly mounted at an acute angle relative to the axis of rotation of the rotor means, and means for driving the rotor means.

2. Apparatus as claimed in claim 1 wherein the rotor means further includes control means to adjust the pitch of the blade means while the rotor means is rotating.

3. Apparatus as claimed in claim 2 wherein the blade means comprises a plurality of propellor blades and the pitch control means is able to vary the pitch of the propellor blades collectively and each equally.

4. Apparatus as claimed in claim 3 wherein the pitch control means is able to vary the pitch of the propellor blades cyclically whereby the pitch of the blades varies over the course of each revolution.

5. Apparatus as claimed in any preceding claim wherein the airship is elongate and the rotor means is mounted at at least an end of the airship.

6. Apparatus as claimed in claim 5 wherein the axis of rotation of the rotor means is coincident with the longitudinal axis of the airship.

7. Apparatus as claimed in claim 4, claim 5 or claim 6 and further including means to operate the rotor means and pitch control means to compensate automatically for pitching and yawing motions of the airship.

8. Airship control apparatus substantially as hereinbefore described with reference to the accompanying drawings.

Published 1988 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office, Sales Branch, St Mary Cray, Orpington, Kent BR5 3RD. Printed by Burgess & Son (Abingdon) Ltd. Con. 1/87.